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WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel.

TM-111650

VOLUME 2 -- SERVICE MANUAL

626-PA-6018

IMPULSE ENERGY MONITOR

1 March 1986

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Note: Refer to Volume 1 (Operator's Manual) of TM-111650 for the installation and operation instructions.

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VOLUME II
SERVICE MANUAL

626-PA-6018 IMPULSE ENERGY MONITOR

SECTION IV
THEORY OF OPERATION

4.1 SCOPE AND INTRODUCTION

Volume 2 of TM-111650 provides the service, calibration, and maintenance instructions for the 626-PA-6018 Impulse Energy Monitor plug-in, referred to as the 6018 plug-in. Volume 2 is divided into four sections: (IV) THEORY OF OPERATION, (V) MAINTENANCE AND CALIBRATION, (VI) REPLACEABLE PARTS LIST, and (VII) SCHEMATICS AND GENERAL ASSEMBLY. (See Volume 1 of TM-111650 for the installation, operation, and operational test instructions for the plug-in: Sections I, II, and III.)

4.2 BLOCK DIAGRAM DISCUSSION OF THE ANALOG CIRCUITS

Note: Bold-faced numbers appearing in parentheses refer to the numbered blocks in figure 4-1. The blocks in the figure are numbered at their upper left-hand corners.

4.2.1 Voltage Input Signals

The Analog Circuit's voltage input signals are attenuated by a factor of 512 through the broad band attenuator **(1)**. The signals are then applied to the differential amplifier **(2)** which converts them from differential inputs to a single-ended output with a gain of 1.

The variable gain amplifier **(3)** has a gain of 1, 2, or 4, depending on the full scale voltage range selected. An additional input to the amplifier allows for a calibration signal for the SYSTEM CHECK function. The amplifier's output is applied to the absolute value circuit **(4)** and analog multiplier **(8)**.

Pulses of either polarity applied to the absolute value circuit **(4)** are outputted as positive pulses to the peak detector **(5)**. The peak detector captures the peak value and holds it until it is read and reset.

Output of the absolute value circuit **(4)** is also applied to the analog comparator **(7)**. At the analog comparator the output is compared to the user-programmed threshold voltage represented by the output of an 8-bit digital-to-analog convertor **(6)**.

The voltage calibration source **(22)** connects the -8V reference signal **(12)** to a second input on the variable gain amplifier **(3)**, simulating a 500 volt input to the broad band attenuator **(1)** when calibration input signal (J) is low.

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4.2.2 Current Input Signal

The current input signal derived from a clamp-on current transformer is applied to the line termination network **(14)** which serves to minimize reflections and spurious inputs. The output of the network is applied to the differential amplifier **(15)**.

Blocks **(15)**, **(16)**, **(17)**, **(18)**, **(19)**, and **(20)** in the current channel perform functions identical to blocks **(2)**, **(3)**, **(4)**, **(5)**, **(6)**, and **(7)** in the voltage channel.

The current calibration source **(21)** connects the -8V reference signal **(12)** to a second input on the variable gain amplifier **(16)**, simulating a 400 amp current pulse in the line monitored by the current probe when calibration signal (J) is low.

4.2.3 Analog Multiplier, Analog Comparator, Absolute Value Circuit, & Integrator

The analog multiplier **(8)** multiplies a voltage signal (output of 3) by a current signal (output of 16) to create an output signal which represents instantaneous power. The output of the multiplier is applied to the input of the integrator **(10)**. The integration of power over a period of time produces a signal which represents energy.

The energy signal is applied to the analog comparator **(9)** and absolute value circuit **(11)**. The analog comparator determines the polarity of the energy signal and the absolute value circuit converts all inputs to positive polarity outputs which may read by an analog-to-digital convertor.

The integrator **(13)** integrates a dc input from reference **(12)** to determine pulse duration. Integrating time is controlled by the output of the OR-gate **(14a)** whose output is "true" when either the voltage or current is above the user-programmed threshold [as indicated by the outputs of the two analog comparators: **(7)** and **(20)**].

The block diagram of the analog circuit is illustrated on the following page.

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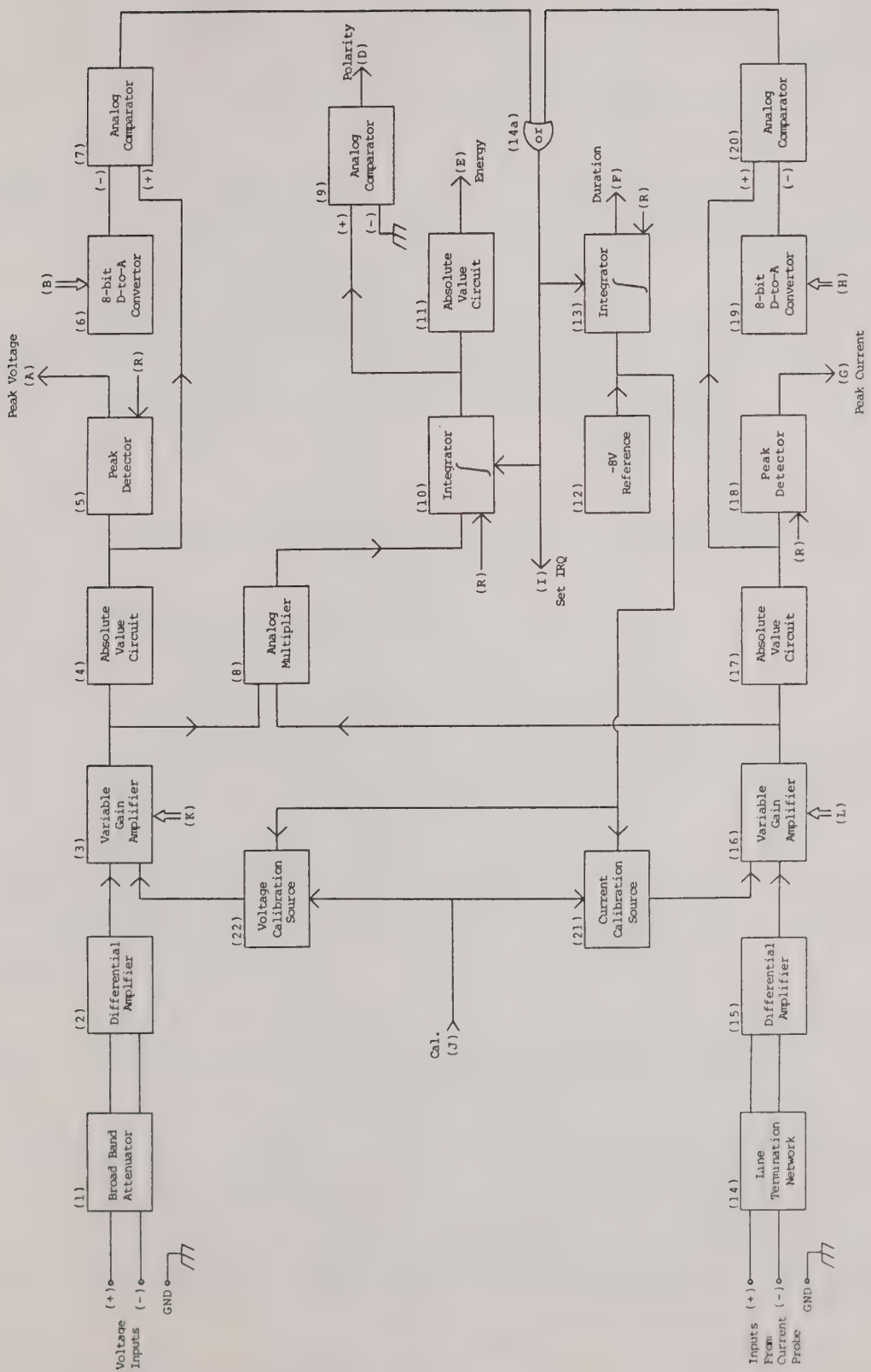

Fig 4-1. Analog Circuit Block Diagram

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4.3 BLOCK DIAGRAM DISCUSSION OF THE DIGITAL CIRCUITS

Note: Bold-faced numbers in parentheses refer to the numbered blocks in figure 4-2. The blocks in the figure are numbered at their upper left-hand corners.

Signals representing peak voltage (A), peak current (G), impulse energy (E), and impulse duration (F) are applied to the inputs of the analog multiplexor **(13)**. The signal selected by the multiplexor is then fed through the amplifier **(12)** to the analog-to-digital convertor **(11)**. The amplifier's gain is 1.25.

Outputs of the analog-to-digital convertor are fed through 8- and 2-bit data buses to octal tri-state buffers **(9)** and **(10)**, and from there to a local 8-bit data bus. The local 8-bit data bus communicates to the Series 626 Mainframe's central microprocessor through the input/output (I/O) buffer **(3)** when required.

4.3.1 Octal Latches

Information from the Mainframe's microprocessor is communicated to the 6018 plug-in through the I/O buffer **(3)** and then stored in octal latches **(5)**, **(6)**, **(7)**, and **(8)**.

Octal latch **(5)** contains the user-selected voltage threshold. The output of this latch is applied to digital-to-analog convertor [see figure 4-1, block **(6)**, input (B)]. Octal latch **(6)** contains the user-selected current threshold value. The outputs of the latch are applied to the digital-to-analog convertor [see figure 4-1, block **(19)**, input (H)]. Octal latch **(7)** outputs are used to select analog multiplexor **(13)** inputs, reset analog circuits, and clear the interrupt service requests. Octal latch **(8)** outputs select voltage and current input ranges by controlling the gain of the variable gain amplifiers [see figure 4-1, blocks **(3)** and **(16)**, inputs (K) and (L)]. Its outputs also activate calibration signals for the self-test [see figure 4-1, blocks **(21)** and **(22)**, input (J)] and trigger readings of the analog-to-digital convertor **(11)**.

4.3.2 Interrupt Control Circuits, Decoder, & Program Memory

Interrupt control circuits **(4)** are activated whenever a user-selected current or voltage threshold has been exceeded, as indicated by the output of the OR-gate [see figure 4-1, OR-gate **(14a)**].

The Decoder **(2)** provides address decoding for Mainframe microprocessor communication with various latches and output buffers.

Program memory **(1)** is used to direct the Mainframe's microprocessor whenever it must interface with the 6018 plug-in. It is connected directly to the Mainframe's data bus, address bus, and board select line.

The digital circuit's block diagram is on the following page.

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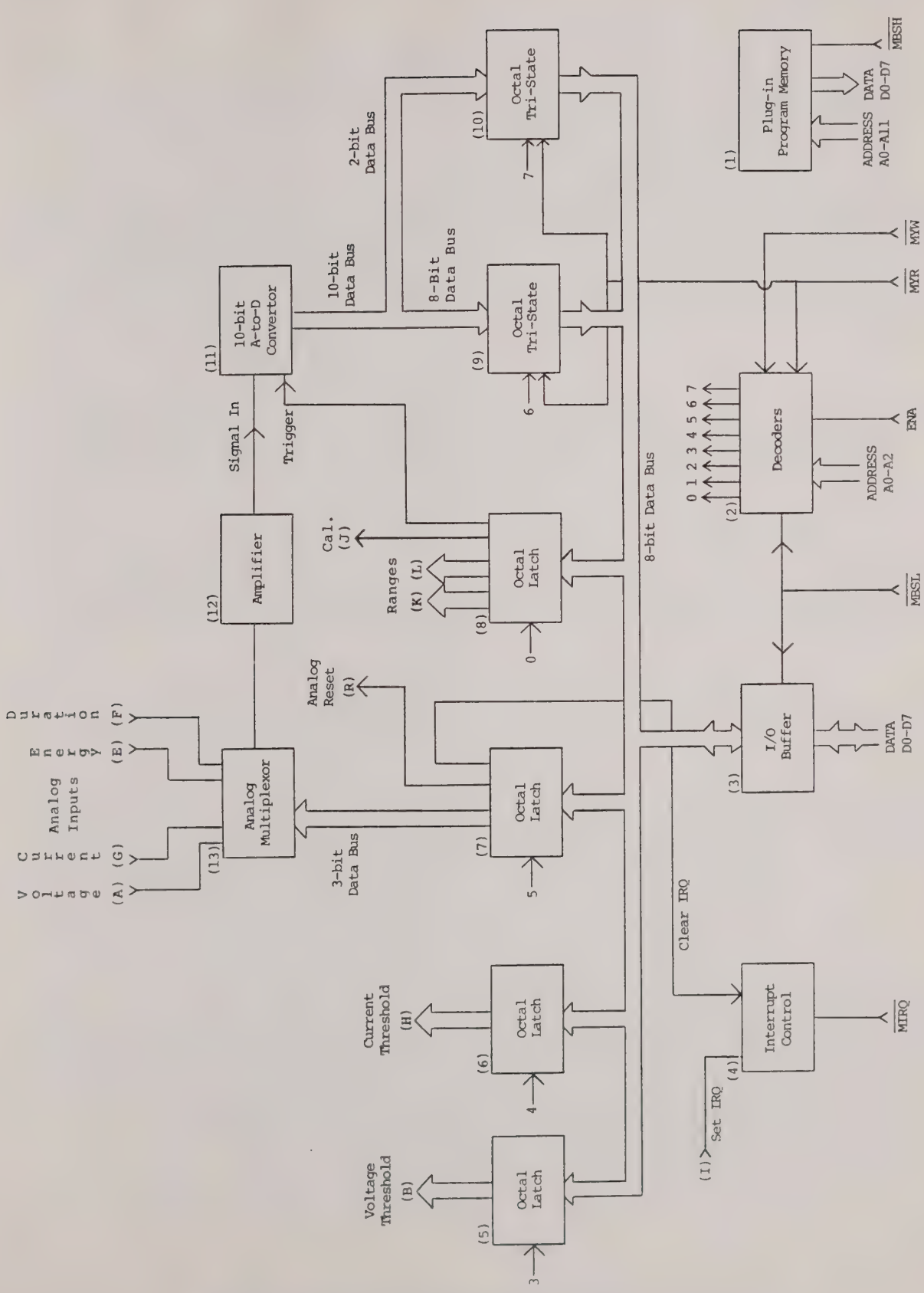

Fig 4-2. Digital Circuit Block Diagram

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4.4 DETAILED THEORY OF OPERATION

Note: Refer to figure 7-2 for the schematic diagram of the Impulse Energy board.

4.4.1 Voltage Attenuation

The voltage input signal at E_1 is applied to a frequency compensated attenuator. R62 and L3 attenuate frequencies above the 6018 plug-in's measurement range. Capacitors C35 and C36 and resistors RN1 and R64 form a 512:1 attenuator. R63 adjusts its frequency response. The voltage input at E_2 is similarly attenuated with R66 providing frequency response adjustment.

4.4.1.1 Differential and Variable Gain Amplifiers (Voltage)

Outputs of the attenuators are applied to a differential amplifier consisting of U26 and U25A (pins 5,6,7). R55A adjusts the common mode rejection of this amplifier while R58A adjusts its gain to a value near 1.

Note: These adjustments interact if not done in correct sequence.

The output of the differential amplifier is fed to variable gain amplifier U25A (pins 1,2,3) through analog switch U24A (pins 9, 10,11). Gains of 1, 2, or 4 are selected as follows:

-- For a gain of 4, analog switches U24A (pins 6,7,8) and U24A (pins 14,15,16) are both open.

-- For a gain of 2, switch U24A (pins 14,15,16) is closed.

-- For a gain of 1, both switches are closed. R49A is used to adjust the dc offset of U25A (pins 1,2,3) to zero. R51A, R52A, and C34A provide an alternate input path to U25A which is used to introduce a calibration signal in the self-test mode. Switch U24A (pins 9,10, 11) is opened and switch U24A (pins 1,2,3) is closed to introduce this calibration signal.

4.4.1.2 Absolute Value Circuit

Output of the variable gain amplifier is applied to an absolute value circuit consisting of U22A and U23A. Positive pulses applied to this circuitry propagate through U23A (pins 5,6,7) and U22A. Negative pulses are inverted by U23A (pins 1,2,3) before being applied to U22A. This results in a positive output from U22A (pin 6) regardless of the input polarity.

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4.4.1.3 Two-Stage Peak Detector

Positive pulses are then applied to a 2-stage peak detector consisting of U20A and U21A. U21A through CR3A charges capacitor C30A to the peak value of an input pulse. Since C30A is a small capacitor, it can be charged rapidly in response to a short duration pulse. It is not capable, however, of holding this value until being subsequently digitized. Therefore, the second stage of the peak detector similarly charges C29A to the peak value of the input pulse. Because C29A is a much larger capacitor than C30A, it holds the peak pulse value for the required time. The output of U20A (pin 1), peak voltage, is then applied to analog multiplexor U5 (pin 4).

4.4.2 Current Attenuation

The current input signal applied to E3 and E4 is the output of a TR-2019 current probe designed for use with the 6018 plug-in. The scale factor of the voltage which is applied between E3 and E4 is 5 mV/Amp, as determined by the current probe.

L1, L2, R70, R72, C39, and C40 provide low-pass filtering to attenuate input signals beyond the 6018 plug-in's frequency range. Resistors R68, R69, and R71 serve as termination for the cable from the current probe to the plug-in. These terminations reduce reflections and pick-up on the input cable.

4.4.2.1 Differential and Variable Gain Amplifiers (Current)

Signals from the termination network are applied to the inputs of differential amplifier U25B (pins 5,6,7). R55B adjusts common mode rejection and R58B adjusts the gain of this amplifier.

Differential amplifier output U25B (pin 7) is applied to the input of a variable gain amplifier. From this point in the circuit to input pin 5 of multiplexor U5, the current circuits are identical to the voltage circuits previously described.

4.4.2.2 Multiplier

Analog signals representing pulse voltage U25A (pin 1) and current U25B (pin 1) are applied to input pins 1 and 6 of multiplier U31. U31 multiplies voltage times current (V x I) to produce an output voltage at pin 12 which represents instantaneous power. R82 zeroes the output offset of U31 while R85 adjusts its gain.

4.4.2.3 Absolute Value Circuit, Peak Detector, Integrator, Comparator, Multiplexor, & Amplifier

The multiplier output representing power is fed through absolute value circuit U22C and U23C, followed by peak detector U20C and U21C, to pin 6 of multiplier U5.

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The power signal is also fed to integrator U29 through switch U30 (pins 6,7,8 and 9,10,11). Because the integral of instantaneous power over a period of time is energy, the output of U29 (pin 6) is a voltage which represents impulse energy. R81 sets the gain of the integrator. Switch U30 (pins 6,7,8 and 9,10,11) connects the integrator when impulse voltage or current exceeds the user-programmed thresholds and disconnects when the impulse voltage and current both drop below these thresholds. Switch U30 (pin 1,2,3) is used to reset the integrator after its output data has been processed.

The output of U29 (pin 6) is fed through the absolute value circuit, U22D and U23D, to pin 12 of multiplexor U5. The same signal is fed to comparator U4 (pins 10,11,12) which senses its polarity, indicating the direction of energy flow. This directional information from U4 (pin 10) is applied to an input of octal buffer U14 (pin 6) where it may be read by the Mainframe's microprocessor when required.

The same signals which control energy integrator U29 also control duration integrator U28 (pins 5,6,7). This circuit integrates a precision reference voltage created by U28 (pins 1,2,3) and CR9. Since the integral of a dc level is a linear ramp, the output of U28 (pin 7) is proportional to impulse duration. This output is fed to pin 7 of multiplexor U5. Switch U27 (pins 1,2,3 and 14,15,16) connects the reference voltage to the integrator when either voltage or current thresholds are exceeded.

R76 adjusts the reference voltage U28 (pin 1) to the -8.0V dc level required. R74 adjusts the gain of integrator U28 (pins 5,6,7) and R89 adjusts its offset voltage.

Multiplexor U5 selects which of its inputs is to be transferred to its output (pin 8) and applied to the input of amplifier U6. U6 amplifies its input signal by a factor of 1.25 and applies it to analog-to-digital convertor U7 (pin 13).

4.4.2.4 Analog-to-Digital Convertor

When triggered, the analog-to-digital convertor digitizes its input signal and applies the 10-bit result to the local data bus through tri-state buffers U13 and U14. Once information is available on this local bus, it can only be transferred to the Mainframe's data bus via transceiver U17 under control of the Mainframe's microprocessor.

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4.4.2.5 Mainframe-to-Plug-in Communication

The Mainframe's microprocessor communicates with the 6018 plug-in via an 8-bit data bus, 12 address lines, and 7 control lines used for various purposes. These purposes are:

1) $\overline{\text{MBSH}}$ (pin 42) is set "low" to address PROM U19 which contains the software unique to the operation of a 6018 plug-in.

2) $\overline{\text{MBSL}}$ (pin 12) is set "low" to address all hardware located on the 6018 plug-in.

3) R/$\overline{\text{W}}$ (pin 27) is set "high" to read from the 6018 plug-in's hardware and "low" to write to the plug-in's hardware.

4) $\overline{\text{MYW}}$ (pin 26) is set "low" to enable decoder U16 which selects a hardware location to be written to.

5) $\overline{\text{MYR}}$ (pin 56) is set "low" to enable decoder U18 which selects a hardware location to be read.

6) ENA (pin 55) when "high" enables decoders U16 and U18 ONLY when address information is valid.

7) $\overline{\text{MIRQ}}$ (pin 7) is set "low" by the 6018 plug-in to interrupt the Mainframe's microprocessor in order to request service when an event has occurred.

User-set voltage thresholds are communicated to the 6018 plug-in by writing the digital value to latch U9. The 8-bit output of latch U9 is applied to digital-to-analog convertor U1 which, together with amplifier U3 (pins 1,2,3), produces an output voltage proportional to the desired threshold voltage. Comparator U4 (pins 2,3,4) compares this threshold voltage to the voltage output of absolute value circuit U22A (pin 6) to determine if an impulse voltage has exceeded the voltage threshold level.

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Similarly, latch U10, digital-to-analog convertor U2, amplifier U3 (pins 5,6,7), and comparator U4 (pins 14,15,16) determine if an impulse current has exceeded the selected current threshold level.

When either U4 (pins 2,3,4) or U4 (pins 14,15,16) signal that a threshold has been exceeded, U4 (pins 6,7,8), acting as a NOR-gate, produces a "low" output which sets IRQ latch U8 (pins 1,2,3 and 4,5,6), triggering 1-shot U15 (pins 1,4). When this 1-shot times-out, the $\overline{\text{MIRQ}}$ line is brought "low" through NAND-gate U8 (pins 8,9,10), signaling the Mainframe's microprocessor that an event has taken place and should be processed.

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SECTION V
MAINTENANCE AND CALIBRATION

5.1 GENERAL

This section contains the maintenance and calibration instructions for the 6018 plug-in. The only required maintenance for the 6018 plug-in is its calibration, which should be done every 12 months. You may return the plug-in to the factory for calibration after contacting Dranetz Service Corp. for instructions (Tel. No. 201-287-2535, TWX: 710-997-9553, Telex: 499-7808, Cable: DRANETZ), or, you may calibrate the plug-in on your own with proper equipment by following the section's instructions.

5.1.1 Maintenance

Read over the entire Maintenance section of TM-111650U, Volume 2 (Series 626 Mainframe manual) before proceeding further.

5.1.2 Service Warning

WARNING

The following calibration instructions are intended for qualified personnel ONLY. To avoid electrical shock, DO NOT perform any service other than that contained in your Operator's manual unless you are qualified.

DO NOT attempt internal service or adjustment unless another person, capable of rendering aid and resuscitation, is present.

Read Instructions Carefully

Because of possible shock or fire hazard, DO NOT perform any service tasks beyond your qualifications. Your qualifications for performing such tasks should be self-determined.

5.2 CALIBRATION PROCEDURE

5.2.1 Plug-in Removal

WARNING

Be sure that the Series 626 Mainframe and all power connected to its modules is turned off.

1) Loosen the plug-in's top and bottom captive screws.

2) Carefully slide the plug-in out of the Mainframe.

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5.2.2 Required Test Equipment

1) Series 626 Mainframe.

2) Extender Card: P/N 110260 (or equal).

3) Calibrated oscilloscope with wave form cursors, digital display, ±2% accuracy, and a minimum band width of 25 MHz.

   Recommended: Tektronix model 2445.

4) 450V dc low current power supply.

   Recommended: Acopian 475 UA02 (or equal).

5) Direct current voltmeter, ±1% accuracy, 0.1 mV resolution on most sensitive range, capable of reading at least 320 V dc on highest range.

   Recommended: Fluke model 73.

6) Test impulse generating circuit (configured to figure 5-1 specifications).

7) 50uS, 10V impulse source.

   Recommended: Wavetek model 162 (or similar).

5.2.3 Extender Card Installation

1) Slide the extender card into the 6018 plug-in's slot until firmly in place.

   Note: If the lettering on the extender card is upside down, the card is upside down, therefore, flip it over before inserting.

2) Attach the 6018 plug-in to the end of the extender card and tighten its captive screws. Using a clipped lead, connect the plug-in's rear panel to the metal chassis of the Mainframe.

   Note: Brace the bottom of the plug-in so that weight of the test equipment does not pull it out of place.

3) Turn on the Series 626 Mainframe.

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5.2.4 Test Impulse Generating Circuit Configuration

The test impulse generating circuit is configured according to figure 5-1.

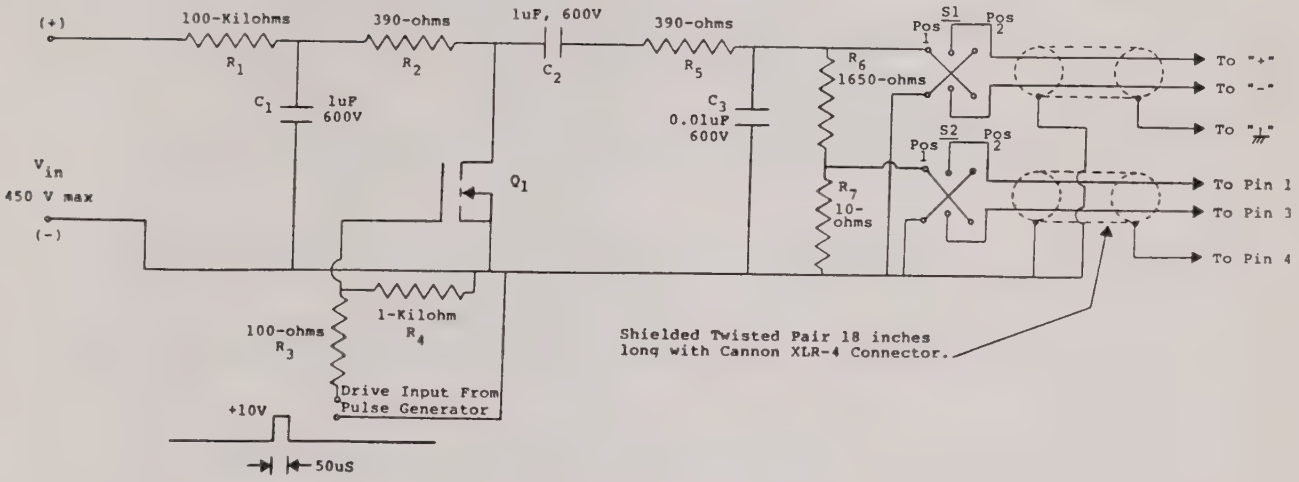

Figure 5-1. Test Impulse Generating Circuit

5.2.4.1 Reference Key to Figure 5-1

Ref.	Description
Q_1	N Channel 500V, 3A, F.E.T. International Rectifier (IRF 830)
C_1, C_2	1.0uF±20%, 600V, Film Cap. CDE MMW6W1
R_1	100-Kilohms±5%, 2W, Carbon Res.
R_2, R_5	390-ohms±5%, 2W, Carbon Res.
R_6	1650-ohms±0.5%, 0.5W, Film Res.
R_7	10-ohms±0.5%, 0.25W, Film Res.
C_3	0.01uF±20%, 600V, Film Cap. CDE MMW6S1
R_3	100-ohms±5%, 0.25W, Carbon Res.
R_4	1-Kilohm±5%, 0.25W, Carbon Res.
S_1, S_2	D.P.D.T. Toggle Switch C&K #7201

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5.2.5 Offset Voltage Adjustments

1) Use the dc voltmeter to adjust the following potentiometers (pots) for 0±0.005 volts with respect to circuit ground ("+" side of C24) at the points listed:

Test Point	Adjustment Potentiometer
U25A, Pin 1	R49A
U25B, Pin 1	R49B
U31, Pin 1	R82
U20C, Pin 1	R87
U28, Pin 7	R89

5.2.6 Reference Voltage Adjustment

1) Use the dc voltmeter to adjust R76 for -8.0±0.1 volts at U28, pin 1.

5.2.7 Frequency Compensation of Voltage Attenuators

1) Using the circuit of figure 5-1 and the dc power supply, apply a -300 volt impulse to the "+" voltage input terminal with respect to the ground terminal.

2) Observe and record the impulse amplitude at U26, pin 7 using an oscilloscope.

3) Remove the impulse source and apply -300 volts dc to the same terminals using the dc power supply.

4) Adjust R63 so the voltage at U26, pin 7 is the same level as observed with the impulse input (step 2).

5) Repeat steps 1 through 4 using inputs applied to the "-" terminal instead of the "+" terminal, and outputs read at U26, pin 1 instead of inputs at U26, pin 7.

6) Adjust R66 accordingly.

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5.2.8 Voltage Gain and CMMR Setting

1) Connect all voltage and current terminals to the test impulse generating circuit as illustrated in figure 5-1.

2) Program the following: 1000 volts F.S.,
500 amps F.S.,
100 volt threshold,
100 amp threshold.

3) Using the test impulse generating circuit, apply a -300 volt impulse between the "-" input voltage input terminal (S1, Pos 2) and ground.

4) Adjust R58A for a printout of 300 volts by the Series 626 Mainframe.

5) Apply a -300 volt impulse between the "+" input voltage terminal and ground (S1, Pos 1).

6) Adjust R55A for a printout of 300 volts by the Series 626 Mainframe.

5.2.9 Current Gain and CMMR Setting

1) Apply a -1.5 volt impulse between pin 3 of the current probe connector and ground (S2, Pos 2).

2) Adjust R58B for a printout of 300 amps by the Series 626 Mainframe.

3) Apply a -1.5 volt impulse between Pin 1 of the current probe connector ground (S2, Pos 1).

4) Adjust R55B for a printout of 300 amps by the Series 626 Mainframe.

5.2.10 Duration Gain Setting

1) Apply a -300 volt impulse between the "+" voltage input terminal and ground (S1, Pos 1).

2) Using the oscilloscope's cursors and digital display capability, record the time that the impulse voltage remains above the 100-volt level.

3) Adjust R74 for a duration printout identical to the one of step 2.

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5.2.11 Energy Gain Setting

1) Apply a -300 volt impulse between the "+" voltage input terminal and ground (S1, Pos 1).

2) Using the oscilloscope's cursors and digital display capability, record the time that the impulse voltage remains above the 100-volt level.

3) Calculate the impulse energy in Joules as follows:

$$E = K_1 V^2 \text{ Delta(t) Joules}$$

where: K_1 is 0.87 for the impulse wave shape generated by the source of figure 5-1.

V is the impulse peak voltage of 300 volts.

Delta(t) is the time that the impulse voltage exceeds 100 volts (as measured in step 2).

4) Center R85.

5) Adjust R81 for an energy printout as calculated.

6) If R81 has insufficient range, adjust R85 as well.

5.2.12 System Check Calibration

1) Program the plug-in's "PRESET" conditions (refer to the Operator's manual).

2) With no input signals active, request a "SYSTEM CHECK."

3) Adjust R53A for a printout of 500 volts ±1%.

4) Adjust R53B for a printout of 400 amps ±1%.

5.2.13 Finishing Up

1) Remove all test equipment from the plug-in.

2) Turn off the Series 626.

3) Remove the plug-in from the extender card, and then the extender card itself.

4) Carefully reinsert the plug-in and tighten its two captive screws.

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SECTION VI
REPLACEABLE PARTS LIST

6.1 GENERAL

The replaceable parts are listed in table 6-1 which begins on the following page. Contained in the parts list is each part's description, identification number, reference designation, and manufacturer's code. Much of the replaceable hardware was omitted from this table. For further information on the replaceable hardware, contact Dranetz Service Corporation.

6.1.1 Reference Designations

Refer to figure 7-1 in section VII for assembly drawing reference designations of the replaceable parts.

Note: Replaceable parts listed in Table 6-1 are extracted from LM111660.

6.2 Manufacturer's Reference Codes

The manufacturer's reference code from Table 6-1 is:

Man. Code	Source
23207	Dranetz Technologies, Inc. 1000 New Durham Rd., PO Box 4019 Edison, New Jersey 08818-4019 (201) 287-3680
81349	On MIL Specifications list. Manufactured to meet military specifications. Available from a variety of suppliers.

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Table 6-1. Replaceable Parts List (Page 1 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
C1,C2,C4, C5,C12,C17, C18,C21,C23, C25,C26,C42, C44-C59	103209-G2	23207	Cap Fxd Cer, 0.22uF±20%, 50V
C3,C6,C29A-C	104092-G1	23207	Cap Fxd Met-Poly, 0.01±10%, 50V
C8,C10,C13, C14	104027-G2	23207	Cap Fxd Cer, 10pF±5%, 500V
C16,C33A-D	104022-G3	23207	Cap Fxd Mica, 56pF±5%, 100V
C19	104006-G1	23207	Cap Fxd Tant, 1uF±10%, 50V
C20	104018-G2	23207	Cap Fxd Mica, 47pF±5%, 500V
C22,C24	104067-G4	23207	Cap Fxd Tant, 15uF±10%, 16V
C27	104067-G3	23207	Cap Fxd Tant, 56uF±10%, 6V
C28A-C,C32D	104018-G5	23207	Cap Fxd Mica, 150pF±5%, 500V
C30A-C,C34A	104011-G1	23207	Cap Fxd Mica, 100pF±5%, 100V
C31A-C	104018-G4	23207	Cap Fxd Mica, 120pF±5%, 500V
C32A-C	104020-G1	23207	Cap Fxd Mica, 470pF±5%, 100V
C34B	104022-G4	23207	Cap Fxd Mica, 200pF±5%, 500V
C35,C38	104093-G1	23207	Cap Fxd Mica, 43pF±5%, 1000V
C36,C37,C41	104092-G3	23207	Cap Fxd Met-Poly, 0.022±5%, 50V

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Table 6-1. Replaceable Parts List (Page 2 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
C39,C40	104021-G1	23207	Cap Fxd Mica, 1000pF±5%, 100V
C43	104092-G2	23207	Cap Fxd Met-Polv, 0.01uF±5%, 50V
CR1A-B,CR2A-B, CR3A-C,CR4A-C, CR5A-D,CR6A-D, CR7A-D,CR8A-D	104412-G2	23207	Diode
CR1C,CR2C	102899	23207	Diode
CR9	103295	23207	Diode, Zener
Q1A-C,Q2A-C	104515	23207	Transistor
L1,L2	103580-G1	23207	Ferrite Bead
L3,L4	103580-G4	23207	Ferrite Bead
R1,R2,R4,R5	RN55C4021F	81349	Res Fxd Flm, 4.02K±1%, 1/10W
R3,R6	RN55C2051F	81349	Res Fxd Flm, 2.05K±1%, 1/10W
R7,R8,R11, R12,R19,R20	RCR07G362J	81349	Res Fxd Comp, 3.6K±5%, ¼W
R9,R13	RCR07G624J	81349	Res Fxd Comp, 620K±5%, ¼W
R10,R14	RCR07G392J	81349	Res Fxd Comp, 3.9K±5%, ¼W
R15	RCR07G332J	81349	Res Fxd Comp, 3.3K±5%, ¼W
R16	RCR07G363J	81349	Res Fxd Comp, 36K±5%, ¼W
R17	RCR07G564J	81349	Res Fxd Comp, 560K±5%, ¼W
R18	RCR07G105J	81349	Res Fxd Comp, 1M±5%, ¼W
R21,R22,R24, R44A-D,R79	RCR07G103J	81349	Res Fxd Comp, 10K±5%, ¼W

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Table 6-1. Replaceable Parts List (Page 3 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
R23	RCR07G223J	81349	Res Fxd Comp, 22K±5%, ¼W
R25	RCR07G203J	81349	Res Fxd Comp, 20K±5%, ¼W
R26	RN55C4991F	81349	Res Fxd Flm, 4.99K±1%, 1/10W
R27	RN55C1241F	81349	Res Fxd Flm, 1.24K±1%, 1/10W
R28	RN55C1130F	81349	Res Fxd Flm, 113±1%, 1/10W
R29A-C, R38A-C, R41A-D	RCR07G222J	81349	Res Fxd Comp, 2.2K±5%, ¼W
R30A-C, R39A-C	RCR07G331J	81349	Res Fxd Comp, 330±5%, ¼W
R31A-C	RCR07G911J	81349	Res Fxd Comp, 910±5%, ¼W
R32A-C, R33A-C, R37A-C	RCR07G107J	81349	Res Fxd Comp, 100M±5%, ¼W
R34A-C, R35A-C	RCR07G512J	81349	Res Fxd Comp, 5.1K±5%, ¼W
R36A-C	RCR07G821J	81349	Res Fxd Comp, 820±5%, ¼W
R40A-D	RCR07G472J	81349	Res Fxd Comp, 4.7K±5%, ¼W
R42A-D, R43A-D	RN55C4321F	81349	Res Fxd Flm, 4.32K±1%, 1/10W
R45A,R45B	RN55E1002B	81349	Res Fxd Flm, 10K±0.1%, 1/10W
R46A,R46B, R47A,R47B	RN55E2002B	81349	Res Fxd Flm, 20K±0.1%, 1/10W
R48A,R48B	RCR07G125J	81349	Res Fxd Comp, 1.2M±5%, ¼W

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Table 6-1. Replaceable Parts List (Page 4 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
R49A,R49B, R82,R87	104701-G8	23207	Res Var, 50K±10%, ½W
R50A,R50B	RN55C4991F	81349	Res Fxd Flm, 4.99K±1%, 1/10W
R51A	RN55C2002F	81349	Res Fxd Flm, 20K±1%, 1/10W
R51B,R86	RN55l002F	81349	Res Fxd Flm, 10K±1%, 1/10W
R52A	RN55C1502F	81349	Res Fxd Flm, 15K±1%, 1/10W
R52B	RN55C1242F	81349	Res Fxd Flm, 12.4K±1%, 1/10W
R53A,R74	104700-G4	23207	Res Var, 10K±10%, ½W
R53B	104701-G7	23207	Res Var, 5K±10%, ½W
R54A,R56A	RN55C4871F	81349	Res Fxd Flm, 4.87K±1%, 1/10W
R54B,R56B, R57B,R59B, R80	RN55C9091F	81349	Res Fxd Flm, 9.09K±1%, 1/10W
R55A	104700-G3	23207	Res Var, 1K±10%, ½W
R55B,R58B, R76,R81,R85	104701-G1	23207	Res Var, 2K±10%, ½W
R57A,R59A	RN55C5111F	81349	Res Fxd Flm, 5.11K±1%, 1/10W
R58A	104701-G6	23207	Res Var, 500±10%, ½W
R60,R61	RCR07G102J	81349	Res Fxd Comp, 1K±5%, ¼W
R62,R67	RN60C1002F	81349	Res Fxd Flm, 10K±1%, 1/8W
R63,R66	104719-G3	23207	Res Fxd Flm, 10K±10%, ½W

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Table 6-1. Replaceable Parts List (Page 5 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
R64,R65	RN55C7502F	81349	Res Fxd Flm, 75K±1%, 1/10W
R68,R69	RN55C8060F	81349	Res Fxd Flm, 806±1%, 1/10W
R70,R72	RN55C2000F	81349	Res Fxd Flm, 200±1%, 1/10W
R71	RCR07G510J	81349	Res Fxd Comp, 51±5%, ¼W
R73	RN55C3572F	81349	Res Fxd Flm, 35.7K±1%, 1/10W
R75	RN55C3011F	81349	Res Fxd Flm, 3.01K±1%, 1/10W
R77	RN55C1102F	81349	Res Fxd Flm, 11K±1%, 1/10W
R78	RN55C6191F	81349	Res Fxd Flm, 6.19K±1%, 1/10W
R83,R88	RCR07G204J	81349	Res Fxd Comp, 200K±5%, 1/10W
R84	RN55C2001F	81349	Res Fxd Flm, 2K±1%, 1/10W
R89	104700-G5	23207	Res Var, 100K±10%, ½W
R90	RN55C1003F	81349	Res Fxd Flm, 100K±1%, 1/10W
R91	RN55C1000F	81349	Res Fxd Flm, 100-ohms±1%, 1/10W
RN1,RN2	104711	23207	Res Network, 40M, 301K
U1,U2	104287-G1	23207	I.C., D-to-A Convertor
U3,U20A-C, U21A-C,U23A-D, U25A-B,U26, U28	104228	23207	I.C., Dual Op-Amp

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Table 6-1. Replaceable Parts List (Page 6 of 6)

REFERENCE DESIGNATION	PART OR IDENT. #	MAN. CODE	DESCRIPTION
U4	104241-G2	23207	I.C., Quad Comparator
U5	104286-G1	23207	I.C., 1 of 8 MUX
U6	104224-G3	23207	I.C. Op-Amp
U7	104365	23207	I.C. 10-Bit A-to-D
U8	104214-G6	23207	I.C., Quad NAND
U9-12	104290-G4	23207	I.C., Octal "D" Flip-Flop
U13,U14	104290-G5	23207	I.C. Octal Buffer
U15	104216-G5	23207	I.C., Dual 1-Shot
U16,U18	104290-G2	23207	I.C., 3-to-8 Decoder
U17	104290-G3	23207	I.C., Octal Transceiver
U19	See PROM Program Listing 105909	23207	I.C. PROM
U22A-D,U29	104251-G1	23207	I.C. Op-Amp
U24A,U24B, U27,U30	104362	23207	I.C. Quad Switch
U31	104288-G1	23207	I.C. Multiplier
Used @ U31	110749-G2	23207	I.C. Socket, 14-pin
Used @ U7	110749-G4	23207	I.C. Socket, 18-pin
Used @ U19	110749-G7	23207	I.C. Socket, 24-pin

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SECTION VII
SCHEMATICS AND GENERAL ASSEMBLY

7.1 GENERAL

This section of the manual contains the schematic diagram and assembly drawing for the 6018 plug-in. The revision levels of the schematic and assembly are indicated on their respective pages.

7.2 ASSEMBLY DRAWING

Illustrated on fold-out page 7-3/7-4 is the assembly drawing of the Impulse Energy Board (6018 plug-in): Assy 111660.

7.3 SCHEMATIC DIAGRAM

Illustrated on fold-out page 7-5/7-6 is the schematic of the Impulse Energy Board (6018 plug-in): Assy 111660, Schem 111665.

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